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THE NATURAL STORAGE OF ENERGY.

THE content of the universe is called matter. Whatever has existence (*Dasein*) is material. Where matter is not there is nothing. It is the thing-in-itself. Its ultimate nature is not known, perhaps cannot be known, since knowing is an attribute of its most complex state. Its proximate nature, however, can be known, and the proper object of philosophy is to penetrate as far as possible into the nature of matter, i. e., to explain the universe.

The simplest hypothesis would seem to be that *the content of the universe consists of an infinite number of infinitesimal elements possessing fixed velocities*. The last part of this formula is not hypothetical, but is the essential truth of the established law of the conservation of energy. Moreover, it is not essential to the hypothesis either that the number of elements be infinite or that they be infinitesimal. The assumption is therefore reduced to that of the existence of such elements, which is the assumption upon which all science proceeds.

Space, time, and motion¹ are the three conditions (forms) under which matter exists, and all matter always exists under all three of these conditions. The existence of matter under the conditions of space, time, and motion constitutes its three fundamental *relations*, the extensive, protensive, and intensive. So far as human intelligence reveals the ultimate elements of matter they are perpetually impinging upon one another, which changes the *direction* of their motion without changing its *rate*; that is to say, the constant impacts

¹ It seems strange that Kant did not include motion, along with time and space, as a "form" of all phenomena of the external senses.

of the material elements alters their motions without altering their velocities. This alteration of the motion of matter is the effect of which the impact or collision is the cause. This is causation in its simplest form, and all cause and effect are reducible to it. The idea of force is essentially the same. Force is therefore a compound relation growing out of the three simple relations.

We thus have two categories, matter and relation, the distinction between which is absolute. A relation is immaterial, but it can only subsist between material things. Think away the latter and nothing remains. It may seem superfluous to illustrate this, but the fundamental error of all philosophy has been that of confounding matter with its relations. If one element of matter occupies a different position in space from another there arise two relations of co-existence, distance and direction. No one would call these material. If an element of matter be moving, the time required to pass from one point in space to another compared with an antecedent or subsequent period of time is a relation of sequence, which no one would think of regarding as material. If two moving elements collide, the collision is not itself material. It is an intensive relation. The change of motion produced by the collision is a compound relation, and although it cannot occur apart from matter, it can be thought apart from it, not as matter but as relation.

To show how prevalent is the confusion of matter with relation one only need consider the current theories as to the nature of matter. Such expressions as "centres of force," "collections of properties," etc., unwittingly rob it of existence. Eliminate matter and a centre of force is a centre of relation with nothing to be related. Properties are the forces that matter exerts. Remove matter and there remains nothing to exert force or manifest properties. Dynamism is a form of magic.

The unalterable inherent motion of all the elements of the universe is the fundamental source of all effects, the primal cause of all things—it is the true *causa sui*, *causa immanens*, or self-activity of the philosophers. The multitudinous forms in nature are the products of the inherent motions of the elements of which they are composed, and show that the series of causes and effects which have re-

sulted in the existing state of things possesses a somewhat orderly character, involving a tendency toward the production of systems and symmetrical forms. Primarily there is seen the tendency to concentration due to a principle of attraction among the elements. This may be designated the *gravitant* force. There is, however, at the same time an opposite tendency to dissolution due to a principle of repulsion among the elements. This may be designated as the *radiant* force. These two primary forces interact, and wherever suitably balanced they result in the formation of symmetrical bodies preserved by equilibrating forces. It is this that constitutes true *evolution*, best exemplified in the celestial systems—cosmic evolution—and in organised beings—organic evolution. But looked at from another standpoint, the process may be regarded as one of *organisation*, which is *chemical* up to a certain point, beyond which it becomes *biotic*. In the former the activities are *molecular*, in the latter they are *molar*. The products of the former are *chemical substances*, those of the latter are *organic forms*.

The essential principle of organisation, whether chemical or biotic, is the concentration or focalisation of the otherwise diffuse and little operative activities of the universe in the direction of enabling them to produce increased and definite effects. Each product represents a different mode of storing up the universal energy, so as to expend it in some single, definite direction with an effect corresponding to the degree of concentration. The principle may be illustrated by the increased power of the sun's rays after passing through a lens, the intensity increasing as the area upon which they act diminishes, or by that of an electric coil as compared with the diffused electricity of the air. Every substance is a sort of battery, capable of making effective the otherwise ineffective forces of its elements.

The forces thus condensed and stored up constitute what are called the *properties* of substances, and these properties differ according to the elements of which the substances are composed, that is, according to their constitution. These properties differ quantitatively as well as qualitatively. There are many degrees in which the elements of substances may combine, the resultant combinations

becoming the units of higher degrees or orders of aggregation. The power of substances to produce effects is great in proportion to the degree of organisation.

Passing over the universally diffused and apparently homogeneous interstellar ether, which is the least concentrated form of matter about which anything is known, we seem to detect such degrees in what are called the chemical elements, as evidenced by their different atomic weights, and it is probable that the elements having smaller atoms combine to form those having larger ones. The properties of the latter class are thus rendered proportionally more effective, or, as it is said, more active.

The next stage is attained by the inorganic compounds, i. e., substances composed of chemical elements in various combinations. These differ from the elements of high atomic weights only in the fact that they are capable of artificial dissociation, by which their constitution can be determined. Being, however, of a higher degree of organisation their properties are proportionally more active. The inorganic compounds differ very widely from one another in their degrees of organisation, since this class includes not only those whose combining units are the different chemical elements, but also those which are made up of other inorganic compounds of lower degrees of organisation.

The third stage is that at which the so-called organic compounds appear. This, however, is probably only a convenient classification. It was formerly supposed that all organic compounds were the result of biotic conditions, the products left from the destruction of organised bodies, falling back to a plane intermediate between the purely chemical and the biotic. Such products there certainly are, but there are now known to be many organic compounds which are not so produced, and which can be artificially formed in the laboratory out of their inorganic constituents. The organic compounds also differ immensely in their degree of composition and correspondingly in the activity they display. Their properties differ greatly in their modes of manifestation, taking the form of astringents, narcotics, toxics, etc., in the vegetable alkaloids, and that of instability, changeability, and finally of isomerism in protein,

casein, hemoglobin, and other albuminoids. In each of these ascending stages the capacity for producing effects is enhanced.

Throughout all the stages thus far considered the only activities manifested are molecular. However large the molecules, those of albumen being equivalent to about five thousand hydrogen atoms, their power to act is confined to that which these exert within the systems which in each case characterise their chemical constitution. But this process of molecular recompounding is in the nature of things limited. The combining units become at length so large that they can no longer move among themselves without influencing the mass. This stage, that is, the stage at which molecular is transformed into molar activity, is reached with the appearance of the substance called *protoplasm*. This substance is probably a product of the recompounding of the albuminoids, which represent the highest degree of molecular activity. Protoplasm, therefore, which is the last or highest stage of chemical organisation, may also be regarded as the first or lowest stage of biotic organisation.

The leading property of protoplasm, as already intimated, is its power of spontaneous movement as a mass, which is simply a result of its internal constitution. The difference between spontaneous molecular and spontaneous molar activity is simply one of degree, and the latter phenomenon only surprises those who have not reflected on this fact.¹ It is admitted by all who have studied the constitution of matter that its elements are in a state of constant and perfectly spontaneous activity, but this is only perceptible to sense in the forms of heat, light, electric shock, weight, etc., in none of which is the actual movement among the particles within the range of the organs of sense. Therefore when this motion comes to be conveyed to the mass so as to be visible to the eye it is supposed that some entirely new principle is in operation. The illusion is dispelled by a very little thought devoted to the subject.

This spontaneous mobility manifested by protoplasm is tech-

¹ This is the fundamental fallacy that runs through Dr. George M. Gould's exceedingly original and highly readable book, *The Meaning and Method of Life ; a Search for Religion in Biology* (New York, G. P. Putnam's Sons, 1893), and neutralises the greater part of its contents.

nically called *motility*. It is the fundamental fact contained in the idea of *irritability*, as treated by Lamarck,¹ which, carefully analysed, is seen to consist in nothing else, that is, when kept wholly separate from sensibility, as Lamarck seeks to do. This, however, can only be done in thought. As a matter of fact irritability and sensibility always co-operate, are, indeed, but different aspects of the same fact. They constitute the initial stage of the relation which ultimately subsists between brain-states and states of consciousness, between neurosis and psychosis. The explanation of the origin of sensibility is that protoplasm is of such an unstable and delicate nature that to secure its permanence it must possess some protecting quality and sensibility is such a quality. It is probably the only one that would have served the purpose. To some it may seem that this makes it necessary to invoke design in order to endow it with such a property, but the leading principle of modern biology obviates this. It teaches that protoplasm could not have come into existence at all without this property. If there had been no such property there would have been no protoplasm, no life, no organic world. The same reasoning does away with the necessity of predicating sensibility of the simpler forms of matter, those whose activities are wholly molecular. These are so much more stable that no such quality as sensibility is required to preserve them. It need not, however, be dogmatically denied that ever diminishing degrees of sensibility may pass down into even the simplest forms of matter.

As already remarked, chemical organisation ceased and biotic organisation began with protoplasm. It is the only vital and psychic substance, the true life- and mind-stuff, and all further progress in focalising and utilising the universal energy has resulted from the organisation of protoplasm so as to multiply its power. This has consisted in a series of mechanical adjustments. In the organic world protoplasm is the power while *structure* is the gearing which concentrates that power. Although protoplasm exists in every cell, the main lines through which it works are the nerves, which, in the

¹*Philosophie Zoologique*, éd. Martins, Paris, 1873, Vol. I, pp. 8, 398; Vol. II. pp. 2, 37ff.

higher organisms, consist of large trunks with numerous local reservoirs and innumerable branches permeating all sensitive tissues.

In order that sensibility accomplish its purpose, the preservation of the organism, sensations must be either agreeable or disagreeable ; hence pleasure and pain. The instability of protoplasm renders every part ephemeral. The entire organism is in a state of constant and rapid change of substance (metabolism), and fresh supplies must be momentarily introduced to prevent destruction by waste. The biological principle of advantage is adequate to secure this end. The supply of tissue is attended with pleasure and the actions necessary thereto follow naturally. The same is true of reproduction, which a study of the lowest organisms shows to be theoretically only a form of nutrition. The origin of pain is even simpler. The destruction of tissues results in pain and the actions necessary to prevent it also follow naturally.

Pleasures and pains once experienced are remembered, i. e., they are represented when not present, and there arises a disposition to repeat the former and to avoid a repetition of the latter. This is *desire*, and it becomes the prime motive to action. The organism necessarily acts in obedience to desire, or if there be several desires that interfere with one another it acts in the direction of their resultant. Hence the conative faculty or *will* so called.

Up to and including this stage the *cause* of all activity is generically the same. It is the efficient cause, the *vis a tergo*. *Motive* must be distinguished from *purpose*. Desire and will are simply motive. It is a natural force and does not differ except in degree of complication from any purely mechanical or physical force. But evolution has gone on to another stage. In much the same way as, by adopting a new method, it passed from chemical to biotic organisation, it has, by making another new departure, passed from genetic to telic causation.

The direction of progress was seen at the outset to be toward the greater concentration of cosmic energy, toward making the universal force, whose quantity cannot change, perform more work. This law continues in operation to the last. Telic causation is only another way of accomplishing this end. Just as biotic organisation

was called in where chemical organisation could go no farther, so teleology is resorted to at the point where genesis ceases to be effective. In the last stages before this point is reached the chief agent in nature is will, but, as already stated, its action is direct, the same as mere force in any other form. The new agent differs primarily from all others in being *indirect*. The essential characteristic of the final cause is indirection.

It is a common figure to represent any force as blind. The conative force is still more frequently so characterised. Desire sees no obstacles. Love is blind and blind impulse rules the lower world. But while results are accomplished by this direct method according to the intensity of the impulse and the strength of the organism, it is evident that there is a limit to the achievements of will. Desire must go unsatisfied if its object cannot be attained within this limit of physical strength. With the advance of biotic organisation desire increases more rapidly than does the power to overcome obstacles, and the number and magnitude of the obstacles to the attainment of desired ends thus rapidly increase. Any new advance must look to overcoming these difficulties and to clearing the way for the accomplishment of higher results. Still again the biological law of advantage comes forward. The new device is the *final cause*. It consists of a mechanism for the utilisation of force that is running to waste, and in this respect the economic principle of all evolutionary progress is employed, but the application of this principle is wholly unlike any hitherto made.

The conative power was seen to reside in an organised nervous system with an increasing integration of its parts in subordination to a general directive centre, the brain. The physical progress continued to all outward appearances unchanged except in degree in passing from the conative state which is genetic into the noetic state which is telic, but by insensible degrees a new psychic faculty was evolved. This new psychic faculty in its developed state is called the *intellect*, but it had its nascent and inchoate stages which, though the same in essence, scarcely deserve that name. The name, however, is unimportant. It is only needful to understand its nature.

Its physical nature may be safely said to be unknown. A the-

ory is that there takes place within the substance of the brain a miniature reproduction of the entire panorama displayed by the external world to the organs of special sense, which register all impressions and preserve them for future comparison and use. The mind itself thus actually *feels*, or, as it were, *sees*, not only all that is presented to the senses but all that has been so presented in the past, or so much of it as it has the power to retain. The simultaneous felt presence of so many impressions renders it possible to make comparisons and recognise differences and samenesses. It thus declares agreements and disagreements, which constitute the basis of all *thought*. Agreement of wholes is identity, agreement of parts is similarity. These are the fundamental relations, but there are many kinds of relations, and the intellectual process *per se* is the *perception of relations*.

How, then, does this simple faculty of perceiving relations become a new power in the world for the storage and use of the universal energy? What is the precise form of indirection that so greatly multiplies the effect produced? Is there anything essentially new in the nature of the force constituting a final cause? To the last of these questions a negative answer must be given. There is only one *genus* of cause in the sense of a force, and that is the direct impact. The difference between efficient and final causes must be sought in the mode of their application. While the final cause, as its name implies, is inspired by an end in view, it is in reality not directed toward that end. In mere motive or will, unaided by the intuitive faculty, the force of the organism is so directed, but for want of this faculty it may fail to attain it. The telic power differs essentially from the conative power in being directed not to the end but to some *means* to the end. Intelligence works exclusively through means, and only in so far as it does this does it employ the final cause. Instead of seeking the thing desired it seeks some other thing, unimportant in itself, whose attainment it *perceives* will secure the thing desired. This is the essence of intellectual action and all that constitutes a final cause. It is the process of converting means into ends. It thus becomes necessary that the means be *desired*, otherwise there is no *force* for the accomplishment of re-

sults. So far as the pursuit of the means is concerned the action is purely conative and does not differ from that which pursues the end directly. The whole difference consists in the *knowledge* that the end will follow upon the means. A final cause, therefore, stripped of its manifold concomitants which so obscure its true nature, consists in the pure intellectual perception that a certain end is attainable through a certain means. But this is simply saying that in and of itself it is not a cause at all. Knowledge is merely a *guide* to action. Intellect is a directive agent and can no more be called the cause of the result accomplished than the rudder can be called the cause of the progress of a boat.

There are all degrees in the amount of indirection involved in teleological action, from a mere *détour* necessary to avoid an obstacle to the highest feats of engineering, in which each separate part, say, of a Ferris wheel, must be wrought and put together to make the perfect structure which exists in the mind before the first step is taken. In this latter illustration every effort put forth from the beginning to the end is a direct conative act applied to a means. But the work as a whole is telic, the end being constantly in view. And such is the nature of the entire course of material progress achieved by man. It is by this that he is primarily distinguished from the rest of nature. The human intellect is the great source of telic activity. The works of man are the only ones with which we are acquainted that proceed in any considerable degree from final causes. But if there be any other source of final causes, the process must always be the same—efficient causes applied to means.

It was observed at the outset that in the case of genetic phenomena, i. e., of efficient causes, the effect, if the impinging bodies are inert, is always exactly equal to the cause. This is also true of final causes, so far as their action upon the means is concerned, but the *final* effect, if it can be so called, is usually much greater than the cause or effort expended. Wherein consists this difference? How has the force exerted acquired this increased efficiency? The answer is easy. The final cause is the mind's knowledge of the relations that subsist between the means and the end. But the chief

of these relations, and the only practical one, is the action of other natural forces outside of the agent's will-power or muscular strength. What the mind sees is that such forces exist and are operating in certain directions. What the intelligent agent does is to place the thing he desires but lacks the power to move into the current of such a force which moves it for him. This is the type of teleological action. It is illustrated in its simplest form by the lumberman who puts his logs into the river and lets the current float them to their destination. But the most complicated cases may, by proper analysis, be reduced to this simple principle. Teleology is essentially the utilisation of natural forces, causing them to do what the agent perceives to be useful and wills to be done. The applications of wind, water, steam, and electricity are this and nothing else. All machinery falls into the same class. Civilisation in all its material aspects is but the expression of this truth.

It thus appears that the course of evolution as above sketched has been in the direction from the unorganised and ineffacious toward the organised and efficacious through the process of storing energy in appropriate forms. This has taken place by a series of successive steps, each resulting in a more efficient product, that is, one possessing, in addition to the properties of antecedent products, some new property with a special power of its own capable of better work. The new property may be called its *differentia*, or differential attribute. The thought is embodied in the well-known phrase of Linnæus: *lapides crescunt, vegetabilia crescunt et vivunt, animalia crescunt, vivunt, et sentiunt*; to which might be added: *homines crescunt, vivunt, sentiunt, et cogitant*.

It is possible to arrange these several products of evolution in their ascending order of development, assigning to each the particular property by which it is distinguished from all below it—its *differentia*. There are also certain other special attributes that require to be taken into consideration. These are of three kinds: the nature of their *activities*, the *phenomena* they manifest, and the *cause* through which they work. For example, all activities are either molecular or molar, all phenomena are either physical, vital, or psychic, and all causes are either efficient, conative, or final. The

products themselves have already been enumerated in the order in which they must stand. The universal ether may be placed at the bottom of the scale as representing the most diffuse form of matter with the least power, when not concentrated, of producing effects. Next come the chemical elements, which form a class, although they might themselves be arranged in an ascending series. The inorganic compounds naturally follow the elements, and the same remark applies to them. The organic compounds differ from the inorganic still less than the latter differ from the elements, but they belong above them, and like them, only to a still greater degree, exhibit gradations in efficiency. Protoplasm is their highest expression and spans the chasm between the chemical and the biotic planes of existence. It makes the plant possible and prepares the way for the animal. At the head of the animal series and of the entire system stands man.

The classification thus sketched may be put in the following tabular form :

PRODUCTS	DIFFERENTIAL ATTRIBUTES			
	PROPERTIES	ACTIVITIES	PHENOMENA	CAUSES
Man.....	Intellect	Molar	Psychic	Final Conative
Animals	Feeling			
Plants	Life		Vital	Efficient
Protoplasm				
Organic Compounds ..	Elective Affinities	Molecular	Physical	
Inorganic Compounds.				
Chemical Elements ...				
Universal Ether	Wave Motion			

To the general proposition that properties increase in activity as the constitution of the substances manifesting them increase in complexity, it has been objected that there are certain very complex substances which are at the same time rather inert, as for example, clay; while there are certain simple chemical elements, such as oxygen, that have very active properties.

The first of these objections is simply a misconception of what is meant by complexity. The mere stirring together of heterogeneous materials without natural affinities is not complexity, but confusion. The only complexity contemplated is organised complexity. The substance, to manifest active properties, must be a system so integrated as to put forth the combined energy of all its constituents. This, all true chemical substances are believed to do, which is the reason for the law. But it is not the case with clay and most rocks and "minerals," or of any mere mixtures, whether natural or artificial. Unless a substance has formed itself through its own attractions and natural adaptations it does not come within the class of complex substances under consideration.

The second objection, viz., that those properties are most active whose effects are most manifest or obtrusive, is due to the same qualities of mind which look upon gaudy colors as superior to subdued ones, or a noisy person as more important than a quiet one. Oxygen, it is true, has powerful affinities for a great many other substances and has literally reduced nearly the whole earth to ashes by a process of *eremacausis*, but it is the sword of Attila, and not the spirit of progress. The fitful spell of activity is quickly followed by the embrace of death. Neither is the idea of activity to be gauged by the power to destroy living tissues or to produce effects upon sense in any form. If this were all, the most complex of chemical substances would be the least active. It is the power of doing work that increases with organisation. The power of the albuminoids takes the forms of instability, isomerism, and general adaptability to use in forming tissue and contributing to organic life. Protoplasm itself has no destructive power. Its activities are wholly constructive, and hence infinitely higher than those of oxygen, or even of the most virulent poison. It is life and not death that costs. A bull in a china shop may annul in a moment the result of years of skilled labor. The destructive work of nature is universal, its constructive work is local and limited. The power to create is pitted against the power to destroy. Life is an effort directed against the universal tendency toward death. Expressed in cosmical terms it is the struggle of the radiant forces with the gravitant forces, and is

the result of the interaction of these two forces, neither of which acting alone can produce it. The active agents in this warfare are the several combinations that I have enumerated—the storage batteries of nature. Ethereal vibration, chemical affinity, motility, vitality, sensibility, will, intellect—these are the ascending steps in the cosmical series, and at each step the operative power of nature is increased.¹

A great deal has been said, and is still being said in certain circles, about a counter-force to gravitation, which is conceived as something quite different from the radiant energy as explained above. It is claimed that mind is such a force and is capable under suitable conditions of causing ponderable bodies to rise into the air against the force of gravity. To this alleged force has been given the name of *levitation*. It seems very strange, if such a force exists, that it cannot be demonstrated by the strict laws of physical experimentation in such a manner as to render its acceptance universal, as much so as the fact of magnetism, which, I am bound to say, had it not been apodictically proved, would be equally improbable *a priori*. Be this as it may, I merely wish to say that if such a force actually exists it possesses nothing antagonistic to the principles here laid down. We know that an organised living body is a reservoir of force. That of man, it is true, so far as its direct physical manifestation is concerned, is, even relatively to his size, comparatively small. His power, as has been shown, is chiefly indirect or teleological. But so far as most persons have had an opportunity to observe it, this force is only manifested through the organised system by means of a nervous apparatus directly attached to muscles, tendons, bones, joints, and limbs, which, in an equally direct mechanical way, seize upon material objects that are present and in immediate contact. This must be done to the means even in the most effective applications of the final cause. The simple question is whether there is another way, similar to that of a magnet, by which the stored-up energy of an organised system can act, ap-

¹These views may be regarded as a slight amplification of those expressed in an article on "Cosmic and Organic Evolution" in the *Popular Science Monthly* for October, 1877 (Vol. XI, pp. 672-682).

parently at a distance, but really through the ethereal content of space, and thus counteract the force of gravitation, which likewise acts through the ethereal content of space. There is nothing antecedently impossible, or even improbable in this, only it requires to be demonstrated to the satisfaction of all and put in the way of verification at will.

There can be no such thing as action at a distance. The magnet or the electric discharge does not act through absolutely void space. This is unthinkable. There probably is no such thing as space that is not occupied by some form of matter in some such sense as the atmosphere or any gas occupies space ; not an absolute *plenum*, for this would negate motion, but a partial *plenum* with ample room for the action of particles. It is through space thus occupied that the gravitant and radiant forces must act, and if there is a levitant force it must act through the same medium. The savage thinks the wind immaterial—spirit—as did the founders of language the world over. We have got beyond that stage of culture, but most men are still savages enough to believe that a stone falls to the ground through some immaterial or spiritual power. Another forward step in cosmical conceptions must be taken and it must be realised that there are ethereal as well as aerial storms, disturbances, and activities, and that no phenomenon can take place except by the impact or collision of moving matter, which is the essence of all force or energy, and the only *cause* in the universe.

Laplace has somewhere said that the discoveries of science throw final causes farther back. It would be more correct to say that such discoveries push final causes farther forward. They certainly tend to indicate that man's work alone displays design, and that all conceptions of teleological action outside of man's work are anthropomorphic. The inherent activity of all the elements that make up the content of the universe did not rise above the molecular plane until protoplasm was reached, and up to that point all phenomena were merely physical. While sensibility may be theoretically predicated of protoplasm and may be said to accompany all vital phenomena, it is only at its lowest stage throughout the vegetable world, and nothing that deserves the name of psychic is

found below the animal stage of development. Psychic phenomena are subjective and non-selfconscious throughout the subhuman realm of life, and only the incipient stages of intellectual perception are reached by the highest animals. None but efficient causes are operative until man appears and in his less developed condition, as also in the purely animal state, the power exerted is purely conative—the struggle of the unguided will. Not until the full-orbed reason comes upon the scene does the telic force at last gain sway and begin its triumphant career.

In a very general sense it may be held that cause and effect are always equal, but from the standpoint of the present discussion all progress is due to the increasing difference between effect and cause. This results from the successive differential attributes which are superadded at each evolutionary step. These modify the susceptibility of the products, causing them to react more and more vigorously at each step. The law of the equality of cause and effect ignores these increments of stored energy and assumes absolute inertness in the impinging bodies. But when these increments of energy are taken into account, the effect of impacts loses its simplicity and becomes at length incalculably complex, being in fact the resultant of all the properties involved. To the power from without is added the power from within. There are actions, reactions, and interactions, until in the higher stages of biotic organisation, and especially in the domain of final causes, the disproportion between effect and cause becomes enormous, as, for example, in the case of the lever and fulcrum. This often puts it beyond all power to calculate results. In the domain of purely mechanical causation that controls the heavenly bodies, it is possible to predict remote future events. The astronomer can, as it were, write the biography of the solar system in advance, as is done in computing the nautical almanac so many years ahead of date, but who could write the biography of a new-born infant? Great indeed is man's power of prevision under science. The motions of the planets can be foreknown for an indefinite future, physical and chemical effects are accurately deduced from the known laws of these sciences, the rate of growth and multiplication of plants and animals can be approximately ar-

rived at, the psychic activities of animals can be counted upon with sufficient definiteness to be of great value to man, even the feelings, emotions, and propensities of human beings, with their resulting actions, can be rudely presaged, and the will itself reduced to very general laws ; but when an attempt is made to bring the intellect under the dominion of law, to calculate the orbit of the reason, to determine the path of a thought, all rules of the calculus fail. It is here and not in the will that the nearest approach to freedom is to be found. In all other departments there is some limit to the causal influence, but in the department of the higher mind, where all other forces in nature are brought under subjection, the possibilities are practically unlimited. A brilliant French writer has said that human thought is the sum of all the forces of nature. This is true in the sense that it is the master of nature, although in any strict sense it is not only not a force, but it is not even a cause. The final cause is not itself a cause, it is the appropriation of all causes.

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